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## New Gas Proving Apparatus.

There are few persons aside from the profession among the millions who enjoy the luxury of gas-light, who understand the mysteries attendant upon introducing the gas properly into buildings, and when introduced keeping the service pipes, stop-cocks, and various gas fixtures in working order and free from stoppages or leaks, and the various evils arising therefrom. This department is peculiarly the gas-fitters, to whom, as a class representing an important industry, we are under more obligations than is generally surmised.

To discover the locality of a leak, for instance, in a gas pipe would, in many instances, require more acuteness than is possessed by that oft quoted legal gentleman, a Philadelphia lawyer. Invention has assisted materially to solve the various problems for gas fitters, by supplying instruments to detect leaks readily and for facilitating other difficult operations. Among these we illustrate herewith three of the most important, viz., Getty's Patent Gas-fitter's Proving Pump and Guage, and Getty's Patent Pipe Cutter. The professional gas-fitter and others will readily see by the engravings and description their several advantages.

Figs. 1 and 2—A is the pump; T, air tube; B, check valve; R, hose; L, guage attached to the pipes to be tested. (Seen enlarged in fig. 2) It has a cap, G; a cock, N; an ether cup, D, with cock, C; a valve, M, with rod marked to show the pressure in pounds, a diaphragm OO, and a spring. When the pipes are full of air the pressure raises the rod M above the cap G. Cock H is then closed, and the rod shows the pressure. Should the pipes leak the rod will fall. Ether is put in cup D, and the operation repeated. There is no glass or mercury used, and the guage is so compact it can be carried in the pocket.

Fig. 3—D, forged head block; C, slide; L, a V shaped knife; EE, anti-friction rollers; A, handle rod; B, boss to push slide forward. This cutter works easy—rolls down the burr edge, and is superior in every respect to any yet offered to the public.

These valuable improvements are manufactured by Messrs. McNab & Harlin, 86 John street, whose advertisement will be found on page 121, and of whom further information may be had.

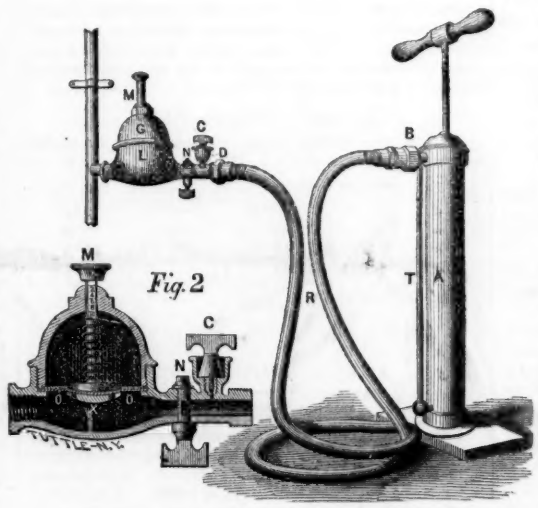


Fig. 2

GAS PROVING APPARATUS.

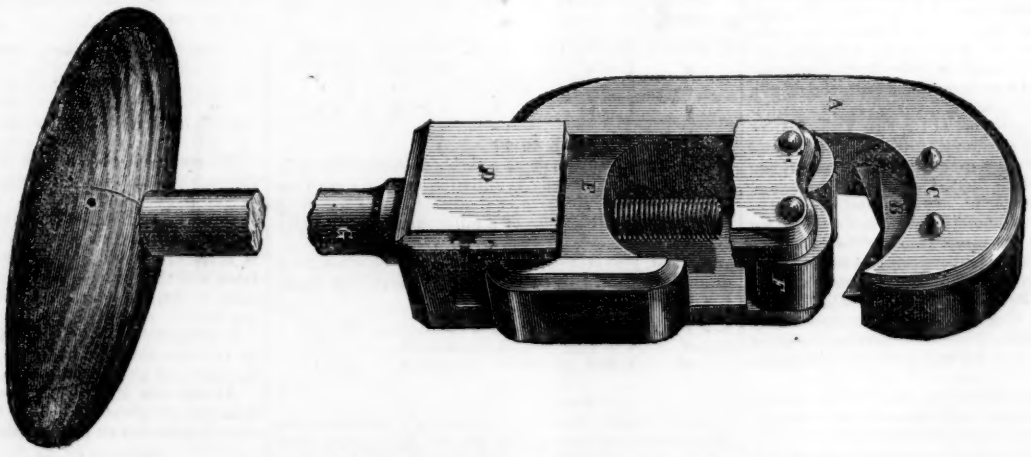

Fig. 3. GETTY'S PATENT PIPE CUTTER.

—The year 1869 will witness the completion of the two greatest engineering enterprises the world has ever witnessed—the Suez Canal and the Pacific Railroad.

## Gas Lamps for Heating Crucibles.

A writer in *Silliman's Journal* describes an improved lamp which he has constructed for the ignition of platinum crucibles in analytical operations. With an ordinary Bunsen burner, the surface of the crucible is more or less acted upon, if in contact with the inner line of the flame. He removes the air tube, and substitutes "a somewhat longer one of glass or iron of about twelve millimetres internal diameter. The gas jet should have a single circular aperture, and be in proper proportion to the diameter of the tube, which may be held in any of the ordinary clamp supports. The tube being raised sufficiently above the jet to allow free entrance of air, and a full stream of gas let on, a 'roaring' flame is produced, of which the interior blue cone is pointed, sharply defined, and extends only about half an inch from the top of the tube. A polished platinum surface is not acted upon by this flame provided it be not brought into contact with the interior cone. In the Bunsen burner, as usually made, the supply of air depends upon the diameter of the tube, the holes at its base being more than sufficient to supply the draught. With the wider tube it is necessary to limit the admission of air by depressing the tube upon the lamp when the force of the gas is diminished. Otherwise the proportion becomes such that an explosive mixture is formed; for this reason it is more convenient to use an arrangement in which the access of air can be regulated by an exterior tube sliding obliquely downward over the air apertures. The gas jet should be on a level with the top of these apertures, which must be much larger than those of the ordinary Bunsen's burner."

A correspondent of the *Irish Farmer's Gazette* proposes the use of the microscope to determine the character of commercial fertilizers.

## On the Proximate Analysis of Coals.

By Prof. Gustavus Hinrichs,
Chemist of the Geological Survey of Iowa.

[From the American Journal of Mining.]

Coal is not a simple chemical combination expressible by a chemical formula; but it is the final residuum of vegetable matter having been exposed to a long-continued and complex process of addition and subtraction. An elementary analysis will, therefore, not teach us much in regard to the nature of the combustible; for who would dare to make any conclusion concerning the peculiar combination of the elements thus determined? Even the heating effect calculated from this elementary analysis is not more trustworthy than the valuation by the reduction of lead.

The proximate analysis, on the contrary, enables us to learn something in regard to the real nature of the fuel. The moisture and the ashes are both not only diluents of the fuel, but in themselves to the effectiveness of the same; the vaporization of the moisture causes a serious loss of heat, while the ashes, by hindering a complete combustion, and by the heat they contain when dropped through the grate, constitute another loss. By furthermore determining the total amount of volatile matter, we learn both the percentage of coke in the fuel, and the amount of carbon (fixed combustible) and bitumen (volatile combustible matter.) Although neither of these two products can be considered as simple chemical compounds, it is nevertheless of the utmost practical importance to know these two quantities, because of the great importance of coke and gas in the arts. The yield in gas of a fuel is no doubt measured by the percentage of bitumen, at least for coals from the same basin—coals which therefore may be supposed to have passed through nearly the same chemical history.

In taking charge of the chemical labors of the Geological Survey of Iowa, I have great doubts in regard to the value of this proximate analysis of coals. No investigation as to its accuracy, nor as to the best method of conducting the work, had come to my knowledge. The European chemists seem almost exclusively to rely on the elementary analysis, while in the great government surveys of this country the proximate analysis seems to have been almost as exclusively practiced. But while the former may readily be turned into approximate determinations of the heating effects of the fuel, the latter have, to my knowledge, never been used for such purposes, nor was it at all apparent that they ever could be thus made useful.

In regard to the first condition of all quantitative determinations, that of giving constant results for the same substance, but few observations were accessible, and these rather increased my first distrust. Thus Whitney, nowhere in his report of the coals of Iowa, (Geology of Iowa, vol i., part 1), gives any data whatever in regard to this most important question, although he devotes a very large space to the subject. Only the final results are given; but whether the individual determinations deviated much or little from the same, cannot be ascertained; or, in other words, the degree of accuracy or reliability of his reported results is altogether unknown. The report of Dr. Jas. V. F. Blaney on the coals of Illinois (Geology of Illinois, vol. i., 1866. p. 258–277), insists on the great correspondence of the amount of bitumen volatilized to varying circumstances, but only in general terms, no experimental data being brought forward. Fortunately, this chemist gives for four samples of coal the direct result of two determinations; but the differences between these two determinations on the same sample are respectively

3·04 1·50 1·132 0·07

per cent., the mean of which is 1·48, or very nearly one and a half per cent. This result certainly was not calculated to incline me favorably to the proximate analysis of coals.

On the other hand, the usual applications of coal demand such analysis, and my reduction of the analysis of Whitney and Blaney (mentioned in No. 22 of the *American Journal of Mining*) proves, by the results obtained, that the determinations must be more reliable than the above figures would indicate.

It thus became necessary for me, before making any proximate analysis of the many samples of Iowa coals put into my hands by the State Geologist, Dr. C. A. White, to make a rather extensive and thorough search into the method itself, in order to study its exact value. Since I, in these determinations, according to the varied circumstances, for the same samples of coal, obtained values ranging from 41·77 to 57·32 per cent. for the amount of volatile matter, it seems not only that such investigation was sufficiently called for, but even that it shows the proximate analysis to be worthless; a variation of 15·54, or rather 16 per cent. for the same sample, seems to condemn the method admitting of such results.

In the determination of magnesia, as large variations could be obtained by exposing the crystallized double phosphate to various conditions; and yet this determination, properly executed, is one of the most accurate known in analysis.

It is easily seen that the following elements will modify the result of the amount of volatile matter driven off from a sample of coal contained in a covered platinum crucible:—weight of coal and of crucible, degree and duration of heat, condition of coal. I hope to show that this determination, notwithstanding all these elements, admits of an accuracy of one-tenth of a per cent., equal to that of weighing a gramme exact to the milligramme.

The sample of coal used for this purpose was not selected, but taken at random; it was labelled No. 350, and is from the bottom of Roberts and Fisher's Bank, which bank is 5 to 6 feet thick, 8 miles west of the town of Pella, in Marion County, Iowa. From this sample a very pure piece, free from any visible admixture of either gypsum or pyrites, was selected. By means of 2·760 coal, in coarse fragments of about 1·10 cubic centimetre and a 50 gramme flask, the specific gravity of this coal was found to be 1·328.

### *Determination of the Volatile Matter.*

*Source of Heat.*—A common Bunsen burner was used (red heat) and also a gas burner with six jets, surmounted by a French soufflet cylindrique (white heat) care being taken to keep the gas-cock in the same position by means of an arm of 10 inches in length. These two sources of heat we will denote respectively "B B," and "Blast."

The time was usually measured by means of a small sand-glass, running exactly three and a half minutes; this duration we will denote by *t*. Tuus BB, *t* means that the crucible was exposed to the constant flame of the Bunsen burner during three and a half minutes.

#### *Influence of Quantity of Coal.*

1. Coal pulverized, not dried; heat, BB, *t*; cooled and weighed; then blast, *t*; then weighed again.*

| N. of Exper. | Weight. | Volatile, pr. ct. | Deviation. | Crucible. |
|---|---|---|---|---|
| *d* | 5·360 | 48·24 | —1·14 | 19·2 |
| *n* | 1·910 | 49 58 | +0·20 | 19·2 |
| *e* | 1·147 | 49·87 | +0·49 | 11·6 |
| *o* | 1·031 | 49·85 | +0·47 | 9·4 |

Mean 49·38

2. Coal in small fragments; heat as in 1.

| | | | | |
|---|---|---|---|---|
| *h* | 3·743 | 48·30 | —0·94 | 18·2 |
| *g* | 1·130 | 50·18 | +0·94 | 9·4 |

Mean 49·24

For the same heat, the amount volatilized is the greater the smaller the mass heated; whether the coal is in small fragments or pulverized hardly makes any difference; but since the bitumen passed off more regularly when the coal was pulverized, while, when in fragments, slight explosions sometimes occurred, the coal should be pulverized, for the determination of the bitumen.

3. Coal pulverized, between 1 and 2 grammes; heat as above.

| N. of Exper. | Weight. | Volatile, pr. ct. | Deviation. | Crucible. |
|---|---|---|---|---|
| *n* | 1·910 | 49·58 | —0·19 | 19·2 |
| *e* | 1·147 | 49 87 | +0·10 | 11·6 |
| *o* | 1·031 | 49·85 | +0·08 | 9·4 |

Mean 49·77

giving, as probable error of a single determination only 0·108 per cent., or only 1 milligramme for 1 gramme of coal. This is not greater than that of the weighing itself, in which fractions of a milligramme are usually neglected.

4. Coal, pulverized (new portion) and between 1—2 grammes: heat, BB, *t*; immediately thereafter, blast, *t*, without cooling.

| N. of Exper. | Weight. | Volatile, pr. ct. | Deviation. | Crucible. |
|---|---|---|---|---|
| *a'* | 1·160 | 50·86 | +0 14 | 9·4 |
| *n'* | 1·040 | 50·58 | —0·14 | 11 0 |

Mean 50·72

Another determination was made (*o'*), but on account of side-draft while over B B, the crucible cooled several times; correspondingly the result deviated much, being only 49·10.

From 3 and 4 we conclude, that if the substance taken is from 1 to 2 grammes, the result will be constant for the same mode of heating.

#### *Influence of Drying the Coal before Ignition.*

5. Coal, fragments; heat, B B, *t*; not cooled; blast, *t*, with the probable error of one single determination, 0·45.

| N. of Exper. | Weight. | Volatile, pr. ct. | Crucible. |
|---|---|---|---|
| *t* | 1·361 | 48·49 | +0·76 |
| *u* | 1·060 | 47·26 | —0·47 |
| *v* | 1·030 | 47·43 | —0·30 |

Mean 47·73

Comparing this with 4 (same heating), it appears that about 3 per cent. less volatilized by previous drying, and also that the accuracy of one determination is four times less than when the coal is ignited without previous drying. In the arts, the coal is not artificially dried before coking. For all of these reasons the amount of volatile matter is best determined on undried coal.

6. In general, I found, as means,

4 dried coals gave 47·97 per cent. volatile.
10 undried " 49·87 " "

confirming the above.

#### *Influence of Cooling after the Ignition over the Bunsen Burner, and before the Ignition over the Blast-flame.*

7. Coal, pulverized, not dried; heat, B B, *t*; then blast, *t*, without cooling.

| N. of Exper. | Weight. | Volatile, pr. ct. | Crucible. |
|---|---|---|---|
| *x* | 1·314 | 49·01 | —0·02 |
| *y* | 1·156 | 49·05 | +0·02 |

Mean 49·03

which, compared with the corresponding case, 3, giving the mean 49·77, and maximum deviation 0 19, shows that by the intermediate cooling about ¾ per cent. more is volatilized. This probably is due to the fact that the crucible upon cooling is filled with atmospheric air, which, upon renewed ignition, must burn a corresponding amount of coal.

#### *Influence of Repeated Heating, the Crucible being after each Ignition Cooled and Weighed.*

Coal = *r* = 1·628 in crucible 19·2 was dried, then ignited (B B, *t*), and lost 41·77 per cent. Being ignited again in the same way, it lost 2·76 per cent., or in all, 44·53. Being successively ignited seven times, B B, each time for six minutes, the total loss was 52·39, or, in the average for each of these six minute B B ignitions, 1·12 (two of the determinations nearest this average were 1·06 per cent).

Hereafter the same was five times for three and a half minutes exposed to the blast; the volatile passed off amounted to 57·31, giving for each of these ignitions the average loss of 0·98 per cent.

It now had been ignited fourteen times, each time having been cooled and weighed; and we have fourteen ignitions, 57·31 volatile—first ignition, 41·77 volatile; hence, average for each of the thirteen ignitions, 1·195, or 1·2 per cent.

This series of experiments shows that it is impossible to heat coal until no further loss is sustained; for it is apparent that each heating, after complete cooling, produces, on the average, more than the additional volatilization of 1. On 1 gramme coal taken, 1 per cent. carbon burnt requires about 30 milligrammes, or 20 centimetres of oxygen. We may, therefore, consider these excesses almost equal losses due to a real combustion.

#### *Influence of Protracted Heating.*

9. Coal, pulverized, not dried; heat, always first B B, *t*; and then immediately, without cooling, transferred to blast-lamp.

| No. | Weight. | Blast. | Volatile. | Difference. | Difference per min. |
|---|---|---|---|---|---|
| *a'*+*n'* | (mean) | 3 min. | 50·72 | 0·57 | 0·19 |
| *c'* | | 6 " | 51·29 | 1·04 | 0·35 |
| *b'* | | 9 " | 52·33 | 1·95 | 0·65 |
| *d'* | | 12 " | 54·28 | 2·93 | 0·16 |
| *k'* | | 30 " | 57·21 | | |

By comparing each with the first mean, we obtain for each minute blast after the first three, respectively,

0·24 0·39 0·27 0 20

showing less difference than the above.

The volatilization, after the three first minutes blast, is therefore increasing ¼ to 2·5 per cent. for six minutes, and then very slowly decreasing to about 2·5 per cent. for half an hour. At this rate the loss is twelve per hour.

It is apparent that the loss is less than when cooled in the intervals, but it proves that a slight current of air must get at the coal in the covered crucible.

At any rate it is demonstrated that the rule which is sometimes given, to heat until no further loss is sustained, demands an impossibility.

#### *Influence of the Degree of Heat.*

10. Coal, not pulverized, not dried; heat, B B, *t*; cooled and weighed; then blast, *t*; cooled and weighed again.

*After* B B.

| N. of Exper. | Weight. | Volatile, pr. ct. | Crucible. |
|---|---|---|---|
| *n* | 1·910 | 48·08 | +0·42 |
| *e* | 1·147 | 47·69 | +0·03 |
| *o* | 1·031 | 47·23 | —0·43 |
| | Mean .. | 47·66 | |
| | Prob. error | 0·284 | |

* Weight—coal taken in grammes; crucible—weight of the same. Deviation per cent. from the mean given. These quantitatives are given in the same order in all subsequent tables, unless stated otherwise.

*After Blast.*

| N. of Exper. | Volatile, pr. ct. | Deviation. |
|---|---|---|
| *n* | 49·58 | —0·18 |
| *e* | 49·87 | +0·11 |
| *o* | 49·85 | +0·09 |
| Mean .. | 49 76 | |
| Prob. error | 0 108 | |

showing that the higher temperature gives the most accurate results.

*Result.*

From this investigation we conclude—

The total volatile matter of coal is determined with accuracy (1 mgr. on 1 gr. coal) by taking 1 to 2 grammes of undried, pulverized coal, heating it for three and a half minutes over a Bunsen burner (bright red heat), and then immediately, without cooling, for the same length of time, over a blast gas-lamp (white heat).

## Carvalho's Superheater.

This valuable and important invention for the economization of fuel, has been satisfactorily tested in the large boiler which is supplying the steam for the engines at the Pavilion. Nothing could be more simple or more natural than the increased power from the same quantity of fuel, or from the same amount of steam when superheated. As the moist steam leaves the boiler in pipes leading to the engine and is exposed to the cold air, much of it is condensed to water and rendered ineffective. The superheater is merely a double winding of pipe filled with coils of iron wire to absorb the heat and impart it to the steam, which conducts this same steam back again through the fire, heating it to 500°, before transmitting it, and making it perfectly dry. The gain in effectiveness is estimated at 25 to 35 per cent. The principal difficulty of the engineer at the Fair, since it is applied, has been to keep the fires low enough to avoid getting on too much pressure.

The advantages of this invention are evident when it is remembered that most of the steam generated in boilers passes through a greater or less depth of water before reaching the surface, and so becomes unavoidably charged with moisture, while the water which is thus carried over by the steam has been highly heated at the expense of the fuel, is of no benefit for power, and of little avail for heating or drying purposes. The amount of water mechanically mixed with ordinary steam is further increased by the condensation which is constantly taking place in cylinders and steam pipes, while if the boiler "primes," as is quite common, the evil referred to is aggravated. The volume and elasticity of this wet steam are necessarily very greatly increased by drying it before use; and though this principle has long been known, advantage has never been taken of it practically on account of the expense and want of durability of the apparatus used, a difficulty which has now been successfully overcome. Being no longer a matter of experiment, the application of the superheater to all ordinary steam boilers is a mere question of economy, which can be very speedily determined by those who are interested.

These superheaters are manufactured at the Ætna Iron Works, for Robert S. Harris, agent for the Pacific Coast. We learn from Mr. John L. Constable, who is the engineer, that they are being adopted into use in various sections of the country.—*Scientific Press.*

**Application of Petroleum to the Heating of Boilers.**—It is under the superintendence of H. M. Sainte Claire Deville that complete investigations have been made with a view to arriving at the means of burning, under suitable conditions, rough petroleum in the fire-grates of steam boilers. For some years past the English and the Americans have devoted themselves to the consideration of the subject, but without seeming to have arrived at any definite conclusions. Numerous trials here, however, have led to the desired result, and a first practical application thereof was made in the beginning of June last, in the grates of the boat Puebla. Not many days have elapsed since the Imperial train was drawn from Chalons to the camp, over a distance of 28 kilometres, by a locomotive heated with petroleum oil, and this trial appears to have been crowned with success. In heating with oil of petroleum, employment is made, not of the rectified oil adapted for trade, but of an oil dull, almost stationary, viscous as tar, and in this state not presenting any danger of explosion. The mode employed on the Eastern Railway consists in burning the petroleum on a nogging placed behind a simple vertical grating. A constant current, the paying out of which is regulated by a cock, comes to supply aliment for the combustion, and consequently allows the regulation of the production of the steam. Whether this trial will be followed by other applications, and whether petroleum will enter as a manufacturing agency of combustion into the actual practical working of steam engines, are questions which the futute will decide.—*La Houille.*

## On the Source of Light in Luminous Flames.

A Lecture delivered before the Royal Institution of Great Britain, Friday, June 12, 1868, by Professor Frankland, F. R. S.

The most prolific source of error among mankind is the unquestionable acceptation of authoritative opinion. However much we may pride ourselves upon the sifting of the explanations of things by our own enlightened judgments, it cannot be denied that the *ipsi dixit* mode of settlement is still wonderfully frequent among us. Not only is this the case with the public in general, but even the cultivators of science are not entirely innocent of the same weakness.

The essential difference between a fact and a theory is not always appreciated with sufficient vividness. The statement that "sixteen parts by weight of oxygen unite with two parts of hydrogen to form water," is considered by many, for instance, as perfectly synonymous with the assertion that "one atom of oxygen unites with two atoms of hydrogen to form water."

The existence of an imponderable ethereal medium filling all space is often regarded as equally certain with the presence of a gaseous envelope surrounding our globe.

The atomic theory and the hypothesis of an ethereal medium are, at present, absolutely necessary, the one to the progress of chemistry, the other to the further development of physics; but neither this circumstance ner the splendid discoveries made by their aid can establish their truth. A mathematician starting from false data is sure to arrive at a false result; but it is far otherwise with theory, for false theories can, and constantly do, conduct to true facts. Thus Columbus's counterpoise theory of the earth led to the discovery of America, although that theory was nevertheless essentially false.

The most sober worker in science cannot progress without the assistance of theory to co-ordinate his facts, and to lead him on to further research. It is here that even a false theory is invaluable, and it is only when the theory continues to be held after it has becume opposed to facts, that it exercises a prejudicial influence upon the progress of science. Then it hinders rather than expedites the advance of the experimenter, and ought to be at once abandoned.

In pursuing the investigation forming the subject of this discourse, the speaker had been compelled thus to abandon a theory of the source of light in luminous flames, which he, in common with others, had derived from Davy's classical researches on flame.

Our text-books answer the question—What is the source of light in a luminous gas or candle flame? in the most positive and unanimous manner.

Selecting from some of the most celebrated, the following quotations may be made:

"All our artificial lights depend upon the ignition of solid matter, in the intense heat developed by the chemical changes attendant on combustion."—*W. A. Miller.*

"Whenever hydrocarbons are imperfectly burnt, there is a deposition of carbon, and this temporary deposition of carbon is an essential condition for the production of the white light required in an ordinary flame."—*Williamson.*

"The illuminating power of the gas flame is therefore due to these carbon particles, which are afterwards burned nearer the border of the flame."—*Balfour Stewart.*

"The brightness or illuminating power of flame depends not only on the degree of heat, but likewise on the presence or absence of solid particles which may act as radient points. A flame containing no such particles emits but a feeble light, even if its temperature is the highest possible."—*Watts.*

The speaker then proceeded to investigate a number of different flames: he showed that there are many flames possessing a high degree of illuminosity which cannot possibly contain solid particles. Thus the flame of metallic arsenic burning in oxygen emits a remarkably intense white light; and as metallic arsenic volatilizes at 180° C., and its product of combustion, arsenious anhydride, at 218° C., whilst the temperature of incandescence in solids is at least 500° C., it is obviously impossible here to assume the presence of ignited solid particles in the flame. Again, if carbonic disulphide vapor be made to burn in oxygen, or oxygen in carbonic disulphide vapor an almost insupportably brilliant light is the result; now fuliginous matter is never present in any part of this flame, and the boiling point of sulphur (440° C.) is below the temperature of incandescence, so that the assumption of solid particles in the flame is here also inadmissible. If the last experiment be varied by the substitution of nitric oxide gas for oxygen, the result is still the same; and the dazzling light produced by the combustion of these compounds is also rich in the more refrangible rays that it has been employed in taking instantaneous photographs, and for exhibiting the phenomena of fluorescence. Lastly, amongst the chemical reactions celebrated for the production of dazzling light, there are few which surpass the active combustion of phosphorus in oxygen. Now phosphoric anhydride, the product of this combustion, is volatile at a red heat,* and it is therefore manifestly impossible that this substance should exist in the solid form at the temperature of the phosphorus flame, which far transcends the melting point of platinum.

For these reasons, and for others which the speaker had stated in a course of lectures on "Coal-Gas," delivered in March, 1867, and printed in the *Journal of Gas Lighting*, he considered that incandescent particles of carbon are not the source of light in gas and candle flames, but that the luminosity of these flames is due to radiations from dense but transparent hydrocarbon vapors. As a further generalization from the above mentioned experiments, he was led to the conclusion that dense gases and vapors become luminous at much lower temperatures than aeriform fluids of comparatively low specific gravity: and that this result is to a great extent, if not altogether, independent of the nature of the gas or vapor, inasmuch as he found that gases of low density, which are not luminous at a given temperature when burnt under common atmospheric pressure, become so when they are simultaneously compressed. Thus mixtures of hydrogen and carbonic oxide with oxygen emit but little light when they are burnt or exploded in free air, but exhibit intense luminosity when exploded in closed glass vessels, so as to prevent their expansion at the moment of combustion.

In a communication made to the Royal Society the speaker had described the extension of these experiments to the combustion of jets of hydrogen and carbonic oxide in oxygen under a pressure gradually increasing to twenty atmospheres. These experiments, which were conducted in the laboratory of the Royal Institution, were made in a strong wrought-iron vessel furnished with a thick glass plate of sufficient size to permit of the optical examination of the flame. The appearance of a jet of hydrogen burning in oxygen under the ordinary atmospheric pressure was exhibited. On increasing the pressure to two atmospheres, the previously feeble luminosity was shown to be very markedly augmented, whilst at ten atmospheres' pressure, the light emitted by a jet about one inch long was amply sufficient to enable the observer to read a newspaper at a distance of two feet from the flame, and this without any reflecting surface behind the flame. Examined by the spectroscape, the spectrum of this flame is bright and perfectly continuous from red to violet.

With a higher initial luminosity, the flame of carbonic oxide in oxygen becomes much more luminous at a pressure of ten atmospheres than a flame of hydrogen of the same size and burning under the same pressure. The spectrum of carbonic oxide burning in oxygen under a pressure of fourteen atmospheres is very brilliant and perfectly continuous.

If it be true that dense gases emit more light than rare ones when ignited, the passage of the electric spark through different gases ought to produce an amount of light varying with the density of the gas; and the speaker showed that electric sparks passed as nearly as possible, under similar conditions, through hydrogen, oxygen, chlorine, and sulphurous anhydride, emit light, the intensity of which is very slight in the case of hydrogen, considerable in that of oxygen, and very great in the case of chlorine and sulphurous anhydride. On passing a stream of induction sparks through the gas standing over liquefied sulphurous anhydride in a strong tube at the ordinary temperature, when a pressure of about three atmospheres was exerted by the gas, a very brilliant light was obtained. A stream of induction sparks was passed through air confined in a glass tube connected with a condensing syringe, and the pressure of the air being then augmented to two or three atmospheres, a very marked increase in the luminosity of the sparks was observed, whilst on allowing the condensed air to escape, the same phenomena were observed in the reverse order.

Way's mercurial light was also exhibited as an instance of intense light produced by the ignition of the heavy vapor of mercury.

The gases and vapors just mentioned have the following relative densities:

| | |
|---|---|
| Hydrogen | 1 |
| Air | 14.5 |
| Oxygen | 15 |
| Sulphurous anhydride | 32 |
| Chlorine | 35.5 |
| Mercury | 100 |
| Phosphoric anhydride | 71 or 142 |

* Davy mentions this fact in connection with his view of the source of luminosity in flames, and endeavors to explain the, to him, anomalous phenomenon. He says: "Since this paper has been written, I have found that phosphoric acid volatilizes slowly at a strong red heat, but under moderate pressure it bears a white heat; and in a flame so intense as that of phosphorus, the elastic force must produce the effect of compression"—Davy's Works, vol. vi., p. 48

The feeble light emitted by phosphorous when burning in chlorine seems, at first sight, to be an exception to the law just indicated, for the density of the product of combustion (phosphorous trichloride) 68·7 would lead us to anticipate the evolution of considerable light. But it must be borne in mind that the luminosity of a flame depends also upon its temperature, and it can be shown that the temperature in this case is probably greatly inferior to that produced by the combustion of phosphorus in oxygen. We have not all the necessary data for calculating the temperature of these flames, but, according to Andrews, phosphorus burnt in oxygen gives 5.747 heat units, which, divided by the weight of the product from one grain of phosphorus, gives 2,500 units. When phosphorus burns in chlorine, it gives only, according to the same authority, 2,085 heat units, which, divided as before by the weight of the product, gives 470 units. It is therefore evident that the temperature is the latter case must be greatly below that produced in the former, unless the specific heat of phosphoric anhydride be enormously higher than that of phosphorus trichloride. The speaker had, in fact, found that if the temperature of the flame of phosphorus, burning in chlorine, be raised about 500° C. by previously heating both elements to that extent, the flame emitted a brilliant white light.

To return to ordinary luminous flames, the argument of the necessity of solid particles to explain their luminosity obviously falls to the ground; and a closer examination into the evidence of the existence of these particles reveals its extreme weakness. Soot from a gas flame is not elementary carbon, it always contains hydrogen. The perfect transparency of the luminous portion of flame also tends to negative the idea of the presence in it of solid particles. The continuous spectrum of gas and candle flame does not require, as is commonly supposed, the assumption of solid particles. The spectra of the flames of carbonic oxide in the air, of carbonic disulphide, arsenic, and phosphorus in oxygen, are continuous, and so, as we have seen, is that of hydrogen burning in oxygen under a pressure of ten atmospheres. It is to the behaviour of hydrocarbons under the influence of heat that we must look for the source of luminosity in a gas flame. These gradually lose hydrogen, whilst their carbon atoms coalesce to form compounds of greater complexity, and consequently of greater vapor density. Thus marsh-gas ($CH^4$) becomes acetylene ($C^2H^2$), and the density increases from 8 to 13. Again, olefiant gas ($C^2H^4$) forms naphthaline ($C^{10}H^8$), when the vapor density augments from 14 to 64. These are some of the dense hydrocarbons which are known to exist in a gas flame, but there are doubtless others still more dense; pitch, for instance, must consist of the condensed vapors of such heavy hydrocarbons, for it distils over from the retorts in the process of gas-making. Candle flames are similarly constituted. The direct dependence of the luminosity of gas and candle flames upon atmospheric pressure, also strongly confirms the view that the light of these flames is due to incandescent dense vapors.

This inquiry cannot be confirmed to terrestrial objects. Science seeks alike for law in the meanest and grandest objects of creation. From questioning a candle she addresses herself to suns, stars, nebulæ, and comets; the same considerations which have just been applied to gas and candle flames are equally pertinent to these great cosmical sources of light.

## British Association of Gas Managers.

At the Fifth Annual General Meeting of the Members of this association, held on Wednesday, June 3d, 1868, Mr. Thomas H. Methven read the following paper *"On the Necessity and Advantages of Regulation of the Gas Consumed in Public Lamps:"*

For many years public lamps have been a much neglected though an important part of the business of gas companies. The object of this paper is rather to draw attention to the subject than to introduce anything new in connection with it.

Several reasons may be given for the neglect and apathy that have so frequently prevailed. The chief one is, that the contract system so frequently allowed so small a profit that there was no inducement to improvements that entailed any cost. The lamps were therefore lighted and extinguished at the appointed hours, and few inquiries were made by gas companies regarding the quantity of gas consumed in them, neither was much care bestowed upon the best method of getting the full advantage of the light obtained from the gas.

The earlier lamps were badly constructed and small in size, yet the tin-work was frequently so wide as to obstruct the light which would otherwise have passed through the small and dirty panes of glass. To have removed the whole and have substituted larger and better made lamps would have been expensive, so the old pattern was adhered to, even when additions to the number were made.

The lamplighter was instructed to adjust the flames to consume 5 feet per hour. However anxious to obey his instructions, he seldom could do so. Sometimes, in order to economize gas, burners with thin slits were used, which only allowed a consumption of 5 feet per hour at the maximum pressure; of course, much less was consumed towards midnight. This burner wasted a large per centage of light, and gave rise to repeated complaints.

With ordinary burners it was quite true that all the lamps did not consume 5 feet per hour, but many more, and especially those before the lighting commissioners' doors, which consumed nearly double the amount. Frequent disputes arose with the public regarding the quantity of gas consumed, in consequence of which occasionally lamps were supplied through meters.—These were frequently unskilfully attached, and gave very irregular and unsatisfactory registration on that account. Again, when lighted by the company, the lamps consumed excessively, and when by the lighting commissioners the result was quite the reverse.

All confidence was lost in the lamplighter, and hence the double tap was introduced. At first a tap was placed in the upright pipe, and adjusted and placed out of the lamplighter's power. Afterwards both taps were made in one casting, one being adjusted by a key so as to allow 5 feet per hour to pass; the other tap was for the lamplighter's use.

This arrangement was a step in the right direction, although the flames were adjusted rudely by a gauge. It should have been introduced before, when a constant pressure was maintained. I recommend it now to all badly managed gas-works as better than no regulator at all. There are not a few who might at once adopt it. But wherever there is variation of the pressure, say from 20-10ths to 6-10ths after midnight, there it is useless, for if the double tap allows 5 feet to pass at the one period, it will not allow half that quantity to pass at the other.

The attempts to regulate the consumption by fixed orifices having failed, regulators were introduced. Mercurial ones were the first in the field; though correct in principle, yet in practice they were found unsuitable, being too delicate for their exposed position. Then dry governers were introduced, and to these the writer would draw attention; they have a leather diaphragm, having a conical valve attached to the under side of it, and weighted on the top side to allow the consumption required.

The regulator is fixed inside or under the lamp, and is furnished with a burner which, at 16-10ths pressure, consumes 9½ feet per hour. It is well known that a wide slit is the best for obtaining the full illuminating power from the gas consumed. At any pressure under 25-10ths the regulators maintain a uniform flame. In experiment I have found them work with 55 10ths, but I am informed by an engineer who has a hilly district—where the pressure is 34-10ths—to supply, that the pressure forces up the valve so close to the seat that an insufficient light is obtained. This defect might easily be remedied by fixing before the ordinary regulator another adjusted to give 20-10ths pressure.

Not only is there a great advantage to the gas companies resulting from the use of the regulator, but there is also a better light supplied to the public. This arises from the superior description of burner that can be used, and is usually supplied by the manufacturers of these instrumenis. The lamps, however, require to be more carefully constructed than formerly, as, on account of the low pressure at which the gas is consumed, there is a great tendency to unsteadiness and smoke in the flames on windy nights.

The great difficulty in adopting improvements is in the large cost involved; yet, if a plan were resolved on, it might be carried out piecemeal at first, when lamps were repaired or new ones were erected. Then, by an extra effort, the whole might be altered to the advantage of all concerned.

A bad regulator, or an inferior one, is not worth fixing; but several makers produce excellent ones. A good regulator should be easily taken to pieces, so that new diaphragms may be inserted when necessary; it should have burners of incorrodible metal secured to it by the maker, and it should be tested in this complete stage before leaving the factory.

That there is plenty of room for economy in the public lighting may be easily proved by fixing a few meters to the lamps in different parts of the town. The meters should be carefully fixed in air-tight boxes. The writer has found the consumption vary from 5 to 10 feet, and in a somewhat lengthened trial has found the average, with the greatest care in lighting, 6½ feet per hour

With a regulator a better light can be had from 5 feet. Thus, in a town with 300 lamps, lighted 1200 hours annually, 540,000 feet of gas might be saved. In addition to the pecuniary result, which would soon pay for the alteration, there would be this advantage, that the lighting committees and the public would have no such grounds of complaint as too frequently at present exist, and much of that ill-feeling and consequent agitation against gas companies which is so detrimental to the interests of all concerned would be prevented.—*Jour. of Gas Lighting.*

## The New York Society of Practical Engineering.

[REPORTED FOR THE AMERICAN GAS-LIGHT JOURNAL.]

The regular fortnightly meeting of the New York Society of Practical Engineering was held on Tuesday evening, September 29th, at the room No. 24, Cooper Institute, the President, James A. Whitney, in the chair. Mr. L. Holms, hydraulic engineer, read a paper on "The Filtration of Water for Industrial and Domestic Purposes," in which the subject was fully treated in its several bearings.

In his statement of the quality of the water in different cities of the world, the writer asserted that the water supplied to the city of London contains about two and a half per cent. of foul impurities, which must of necessity engender diseases of various kinds, whether such impurities were composed of animalcules, or simply of decaying organic matter. As showing the impossibility of avoiding such ill results without separating the impurities from the water previous to using the latter, it was stated that boiling for hours would often fail to destroy the vitality of animalcules, which, if taken into the system, are capable of producing the deleterious effects just mentioned. The condition at different times of the water supply of certain American cities in respect to impurities was also considered at some length.

The writer then passed to a description of the plans adopted at different times in the old country for filtering water on a large scale. In one of the first, brick tunnels, uncemented at the top were formed in a sandy peninsula which projected into the river Clyde, the object being to supply the city of Glasgow, Scotland. The tunnels converged to a large well, into which the water passed after being filtered through the sand and brick to the tunnels, and was then pumped by steam engines for distribution to the city. Plans of a similar nature are used in the river Trent, and also at a town in France. In both of the cases last indicated the open brickwork tunnels are run under the beds of the rivers, and the sand and gravel of such beds constitute the filtrating media. The chief objections to such a system of purifying the water lies in the fact that the head or pressure is very apt to vary materially at different times, and the filtering medium, if choked or clogged, is from the very nature of the case difficult to repair.

Still another plan, having a general resemblance in some features to the preceding, is to dig a basin near the bank of the river, so that the water percolating or filtering through the soil of the bank may be purified. The bank of the river in this case must necessarily be of a porous texture, but many practical objections are found against this method, among others the gathering of the slimy ooze upon the bank to clog the interstices thereof; and although such basins may serve as settling ponds to allow the deposition of impurities, they can have no very extended utility for purposes of filtration. A plan substantially the same as this is, however, being put in practice at Newark, N. J. In this instance there are two filtering basins adjacent to the Passaic river, from which the water is taken, each one hundred and fifty by three hundred feet in area. Each basin will be connected with the river by two iron pipes and a brick conduit five feet in diameter. The whole, together with a wharf along the river bank, will cost about one hundred and fifty thousand dollars.

The writer also mentioned two French filters, in one of which the filtering material consists of several layers of sand, sponge and charcoal, arranged in a close vessel in alternate layers. In the other the medium is composed of layers of wooly material, such as clippings of wool, laid on frames which constitute the bottoms of the filters. The water is required to pass through five such layers, which, in practice, must be charged at intervals of about five days. He also described the method employed in purifying for manufacturing purposes the waters of the Cart which flows through the town of Paisley, and is blackened by the refuse from the large dyeing establishments on its banks. Vats were sunk in the bed of the stream which were furnished with perforated false bottoms on which the filtering material was laid. The water purified by passing

through the latter was drawn by suitable means from underneath the false bottoms. The writer also explained the construction of a large filter constructed and used in the same town, and which is 100 feet long and 60 feet wide, being divided into three compartments, each of which may be used separately, while the others are being cleansed. They are excavated on a level site to a depth of from six to eight feet, with cement walls. The bed is puddled to the thickness of a foot and on this is laid a cemented pavement. On the pavement are laid fire-brick on edge and about a quarter of an inch apart in one direction, and ten inches in the other. Flat perforated tiles are laid upon these, and upon the tiles several layers of sand graduated in fineness, being finest toward the top, are laid. Two feet of fine sharp sand is placed upon this, the upper six inches of such sand being mixed with ground animal charcoal.

The writer stated that to filter the water supplied to New York city, according to any of the European plans, would require on area of twenty-four acres, and involve an enormous expenditure of money. He also described a close or pressure filter of his own invention which he claimed to be capable of accomplishing the same result with a filtering surface of two thousand square feet, and one distinguishing feature of which lies in the peculiar nature of the filtering material, which was mentioned as an elastic carbonaceous substance, very porous and compressed when in use between perforated or reticulated plates.

The paper was of considerable length and occupied nearly the whole evening. A spirited, though necessarily brief debate succeeded the reading of the paper, which was participated in by Dr. A. W. Hall, Messrs. Harrison, Holms, and others, after which the president announced that the regular paper for the next meeting, to be held at the same place on Tuesday evening, October 13th, would be upon the subject of "Air Motors and Atmospheric Propulsion."

## California Sulphur and Borax.

A San Francisco exchange says: There seems to be a misunderstanding as to the locality from whence the supplies of sulphur and borax now reaching this city regularly from Lake county are obtained. An exchange says that the only deposits of borax thus far discovered are at the bottom of a lake which derives its name from that mineral. This sheet of water is distant from Clear Lake about two miles. The lake is one mile and an eighth in length, and one third of a mile in width. The borax is procured from the bottom of this lake by means of coffer dams, from which the water is pumped, the crystalized borax is found in the mud, at the bottom. These crystals are subsequently dissolved, freed from impurities and re-crystalized, and the product is then packed in boxes and ready for shipment. About five thousand pounds of borax per day is procured and refined in this manner at the works of the company, but this amount, it is expected, will soon be more than doubled, as the company are erecting new machinery and steadily increasing their facilities for refining. The bed from which the crude sulphur is obtained extends over four acres, and the sulphur is found slightly mixed with cinnabar, at a distance of from one to eight feet below the surface. The supply is considered practically inexhaustible, and five tons per day are now being produced.

**Electrical Thermometers.**—A late English invention is an apparatus for employing electricity, in connection with a thermometer, to regulate the temperature of a room. An ordinary mercurial thermometer is provided with a platinum wire inserted in the glass bulb, so as to be in connection with the mercury. Another wire, capable of elevation or depression, is placed at the other end of the thermometer. These two wires connect with two poles of a battery, and forming part of the circuit is an electro magnet, whose armature controls the opening or closing of a valve regulating the admission of hot air. If it is desirable that the temperature of the room should not rise above 60 deg. Fahr., the point of the movable platinum wire is brought to that number on the thermometer. When the mercury registers 60 deg. the circuit is closed, and the armature of the magnet closes the hot air valve, until the temperature becomes reduced, when the valve is again opened. Thus a very nearly even temperature may be maintained—a very desirable object in hot houses.

## The Mines of Australia.

The *Melbourne Australasian* says: Some interesting statistics just issued from the Mining Department show a decrease in the number of miners employed in 1867, as compared with 1866, and an increase in their average earnings. Indeed it is satisfactory to observe that these have been steadily on the rise for the last six years; while we must not lose sight of the fact that the yield of gold does not represent the whole of the miners' earnings; inasmuch as these are supplemented by the tens of thousands of pounds expended in unsuccessful ventures by capitalists in Melbourne and elsewhere. The mean number of miners employed in 1867 was 65,857, of whom about three-fourths were engaged in alluvial operations. Their average earnings per man were £67 10s. 7½d., and those of the quartz miners £158 11s. 8d¾d per head per annum. The machinery, two millions sterling; the estimated value of all claims, £7,461,212; the length of water races, 2,300 miles; and the quantity of gold exported during the past year was 1,433,687 ounces, of which 560,527 ounces were obtained from quartz veins, and 873,160 ounces from alluvial workings. We subjoin an estimate of the value of the metals and minerals raised in the colony from the first discovery of the gold fields to the 31st December, 1867:

| | |
|---|---|
| Gold, 38,910,952¾ ounces | £136,648,811 |
| Silver, 12,591 oz., at 5s. 6d. per oz. | 3,462 |
| Tin | 105,045 |
| Copper | 4,673 |
| Antimony | 30,426 |
| Coal, 1,933 tons, at £1 10s. per ton. | 2,899 |
| Lignite, 235 tons, at 17s. 6d. pr ton | 205 |
| Kaolin, 1,757 tons, at £4 per ton | 7,028 |
| Flagging | 18,663 |
| Slates | 508 |
| Magnesite, 6½ tons, at £2 per ton | 12 |
| Diamonds, about 80 carats, at an average of, say £1 per carat | 80 |
| Sapphires, numbers cannot be estimated, say | 150 |
| Total | £135,906,962 |

**Coal on the Pacific Railroad.**—There is coal in great abundance, at not inconvenient distances, all along the Pacific Railroad from Chicago to Salt Lake; from which place on there has been nothing discovered but some thin seams of lignite on the Truckee. At San Pete, 120 miles south of Salt Lake, there is bituminous coal, which is claimed to be better than any west of the Rocky Mountains. At Pahranagat, 300 miles southwest of Salt Lake, there is good coal, and it is believed that coal exists throughout the entire territory of Utah, in large quantities. On the line of the railroad, the principal coal mining district will be about 80 miles east of Salt Lake. Thence eastward, it is found cropping out in the canons everywhere, in masses sometimes fifteen feet in thickness; and it is a matter so common as to attract but little attention. People do not even take the trouble to locate eligible exposures. At Green River, an important halting place on the way, they have found anthracite, which is heavy and will not burn without a flame, but when used in a blacksmith's forge it gives an intense heat. The article has been tried and found to answer for all purposes required. There is no danger of the beds ever being exhausted, so that Green River will be another important source of coal, where something in the way of civilization must necessarily soon plant itself. At Cheyenne coal mining excited a good deal of attention last fall. The mining district around Central City, Colorado, will probably be supplied from Golden City—lying at the entrance to the mountains, between the former place and Denver—which has the appearance already of a bustling little manufacturing town. Going eastward on the Pacific Railroad, the next important coal mining district is in Iowa, a little distance beyond the Missouri river.—*San Francisco Mining Press.*

**The List of Patents** granted during the week ending September 29th embraces the following: Seat for railway cars, Hannibal S. Blood, Jefferson, La.; torpedo for oil wells, Elias Beach, Titusville, Pa.; steering apparatus for sectional boats, William Frich, Middletown, Pa.; coal cutting machine, George Edmund Donisthorpe, Leeds, England; railway-rail joint, Jas. S. Schoonover, Corry, Pa.; starting apparatus for railroad cars, Erastus Woodward and Joseph S. Millett, Charlestown, Mass.; draught valve in railroad car stoves, John E. Wotten, Reading, Pa.

**Carbonizer.**—Among the new patents published in the *American Artisan* of 23d ult., we find the following for a carbonizer: "This invention relates to that class of apparatus used for carburetting air or street gas, in order to render it luminous, which is done by causing the vapor of any hydro-carbon liquid to combine with the air or gas; and as this process requires a constant and regular supply of such liquid for evaporation, the invention consists in a novel construction of gate and trap, by which the flow to the evaporating chamber may be regulated, and any surplus quantity be caused to flow back to the reservoir from which it is taken. It also consists in the application of a hollow valve and stem, suspended from the top of the gasometer, so that by dropping shot or the like through the stem into the valve, the pressure may be regulated and the weight thus applied is in a position to steady the gasometer, and thus prevent the flickering of the light. J. T. and R. H. Plass, of New York City, are the patentees."

**Machine for Mining under Water.**—An exchange says that W. T. Duval, of Georgetown, D. C., has just patented an apparatus applicable to the recovery of gold or other metallic deposits found in the beds of streams, and the removal of sand-bars and similar obstructions to navigation. It is based upon the application of the principle of exhaustion to produce rapid currents of air or water. For working in water a vessel of suitable construction is provided with a steam engine and rotary or centrifugal pump, in which the suction-pipe is so applied as to be capable of extension to any desired length and susceptible of reciprocating vertically, oscillating, or of rotary motion, so that while the pump is at work and producing a current at great velocity, the suction-pipe, being provided with a suitable appliance at its lower end, may be used to dig, bore, or otherwise loosen the deposit, which is immediately drawn up and discharged by the pump into a separating apparatus.

**Test for Naphthalin.**—The following reaction furnishes, according to Vohl, an exceedingly delicate test for naphthalin. When the substance under examination is treated with concentrated nitric acid, and diluted with water, the resulting precipitate is washed first with water and afterwards with dilute alcohol. It is thus placed in a watch-glass with a few drops of potassic hydrate and potassic sulphide, and evaporated to dryness. On moistening the residuum with alcohol, a magnificent red violet color is at once developed.

## Smedberg's "Synopsis of Gaslighting."

The following subscriptions to the above work are acknowledged, making in all 198.

Edwin Keith, Taunton Gas Co., Mass.

B. E. Chollar, Leavenworth Gas Co., Kaesas.

## Fodell's System of Bookkeeping.

The following subscriptions to "Fodell's System of Book-keeping for Gas-Light Companies" have been received, making in all 31:

Samuel Merrill, Raleigh Gas Co., N. C.

## Prices of Gas Coals—Oct. 16.

PROVINCIAL.

| Duty, $1 25 | Coarse. Gold. | Slack. Gold. |
|---|---|---|
| Block House | $1 75 | $0 75 |
| Gowrie | 1 75 | 0 75 |
| Lingan | 1 75 | 0 75 |
| Sydney | 2 13¾ | 0 71¼ |
| Pictou | 2 13¾ | 1 18¾ |
| Little Glace Bay | 1 75 | 1 00 |
| Caledonia | 1 60 | 0 75 |

AMERICAN.

| | Coarse. Currency. | Slack. Currency. |
|---|---|---|
| Westmoreland Co. | $8 50 | $8 00 |
| Despard Coal Co. | 8 25 | 8 00 |
| Penn | 8 50 | 8 00 |
| Newburgh Orrel Gas. | 8 50 | 8 00 |

Delivered in New York.

PRICES OF FOREIGN COALS—DUTY $1.25 PER TON.

| | |
|---|---|
| Liverpool Gas Caking | $ 9 50 |
| " " Cannel | 14 00 |
| " House Cannel | 18 00@19 00 |
| " " Orrel | 16 00@18 00 |

Per ton 2240 lbs., Ex. ship.

PRICES FROM YARD.

| | |
|---|---|
| Liverpool House Orrel, scr'd | $18@$20 |
| " " Cannel, scr'd | $22 |

Per ton, 2000 lbs. delivered.

## The Largest Balloon ever Made—Capable to Receive 350,000 Cubic Feet of Gas.

A London paper contains the following description of a new aeronautical experiment in England: "Over the Ashburnham grounds, immediately to the west of Cremorne Gardens, now floats a balloon of unparalleled dimensions, and which, from the peculiarity of its accompanying machinery, seems likely to acquire a remarkable place in the history of aeronautical science. It is nearly spherical in shape; it is 90 feet in diameter; it is capable of receiving 350,000 cubic feet of gas; and it has a lifting power of eleven tons. Its magnitude will perhaps be brought more distinctly home to the imaginations of our readers by the statement that the receptive capacity of the balloon in which Mr. Glaisher made his important experiments and which was, we believe, the largest one hitherto constructed in England, held only 93,060 cubic feet of gas, or about one-fourth of the quantity which the new aerial monster can afford space. But the use to which this immense power may be applied is perhaps more remarkable and more likely to lead to valuable as well as interesting results than the power itself. Balloons, from their erratic and unmanageable propensities, have hitherto been little better than huge and costly toys. The 'Captive' balloon is placed, in one important respect, under human control, through its connection with the solid earth by means of a cable, just as a boy's kite is held by a string; and to this circumstance, as will be easily understood, it owes its name. This cable is worked by steam from a drum twenty-two feet long and seven feet in diameter. Its weight is two and a half tons, and its length two thousand feet.

"The weight of the balloon, with its car, ropes, and netting, is three and a half tons, and this, with the cable, gives a total dead weight of six tons, so that the available carrying power is five tons, which is about two tons more than would usually be required to lift thirty persons, the number the car is constructed to accommodate. The gas which is to inflate the vast machine, and which is pure hydrogen, requires for its manufacture some two hundred thousand pounds of sulphuric acid, and one hundred and ten thousand pounds of iron filings have to be consumed. So costly and so delicate a work necessarily required some external protection, and an immense circular screen formed of boards and canvas shuts out the public from the space within which the balloon rests. The balloon, with its machinery, is French property, and has been entirely devised, and is almost exclusively worked by Frenchmen. It offers a proof, too, of the enterprise as well as of the skill of our brilliant and ingenious neighbors. It has, we have been informed, involved from first to last an outlay of £28,000; and it is now proposed that some return should be obtained for this investment by charging one shilling to each visitor within the inclosure, and £1 to the aeronauts who ascend in the apparently safe and commodious car.

"Some experimental trips were made with the balloon on Thursday afternoon. In the first of these the ascent took place with mere ballast; in the second, Mr. Godard, son of the celebrated French aerenaut, and M. Yon, who seems to have a large share in the management of the whole undertaking, were the only occupants in the car; in the third, thirty persons, including two French ladies and a boy, filled the ascending vehicle, and after having attained in it to an elevation of nearly two thousand feet—the total length of the cable—returned from their aerial voyage with perfect ease and safety, and evidently much gratified with the novel and striking glimpse of London and its environs which, in spite of the warm haze obscuring the atmosphere, they were thus enabled to obtain. Those private or experimental trips were to have been renewed yesterday, and the show was to have been thrown open to the public to-day; but it was found that a rather considerable escape of gas had taken place; and in the attempt yesterday afternoon an accident took place which may not improbably have the effect of delaying the intended exhibition for several days.

"A gasometer was constructed for the purpose of storing a supply of hydrogen to meet the inevitable waste which will be constantly occurring. A pit or well had, of course, to be dug under this gasometer; and in order to pump the water into the pit one of Merryweather's steam engines was being employed in immediate proximity to the spot on which were standing two rows of barrels in which the gas is generated. The engine was not engaged many minutes in this operation when the sparks from its chimney slightly set fire to some bags filled with iron; it was then stopped for a few moments; but its working having, in spite of the warning thus afforded, been soon renewed, the sparks were next carried to the retorts, causing sixteen of them to explode in rapid succession, and creating a scene of considerable excitement among the whole party filling the grounds. The barrel-heads and the zinc pipes by which they were connected with the gasometer were instantly blown away, and many of the fragments were driven over the lofty screen surrounding the balloon. One of the workmen was struck by a piece of this wood, and was slightly cut in the face, but no other damage, fortunately, was inflicted, and the accident might, certainly, under more unfavorable circumstances, have been attended with far more distressing consequences. As it was, it may render it impossible to recommence the ascent for a few days, but it cannot interfere with the ultimate success of the undertaking in which the constructors of this great balloon have engaged."

## The Electric Light.

When Faraday discovered the great law of magnetic induction, in 1830, he could hardly have anticipated that the principle would be applied to furnishing light for ships on the ocean, for lighthouses, for streets, and for many of the arts and manufactures. Oersted had shown that magnetism could be induced by an electric current, and Faraday reasoned that the converse must be true, and that magnets ought to excite electric currents. Experiments soon proved the correctness of the hypothesis, and it only became necessary to devise a suitable apparatus, to enable the principle to be practically applied. Nearly all of our best electricians have occupied themselves with inventing some form of induction apparatus that could be kept under control, and be ready for use at all times. Although none of them have been entirely successful, all have contributed valuable suggestions, and we appear to be at the present time very near the desired goal.

A French company has succeeded in modifying the magneto-eiectric apparatus of Clarke to such an extent as to be able to secure a constant and powerful current of electricity; and by employing the regulator of Foucalt as modified by Duboscq, and adopting the Fresnel lens, they have rendered the use of the electric light on board of ships and for lighthouse signals, perfectly successful.

The French steamer St. Laurent, as our readers know, has one of these lights; this has been courteously exhibited to us. We descended to the machine-room, where we found a wheel about two feet in diameter and five feet long, which was in fact a helix, making three hundred revolutions a minute, and driven by a one-horse engine, with sections cut in it to fit into 64 horse-shoe magnets, which were permanently fastened around the movable wheel. This device enabled the inventor to revolve a great number of helices around a large battery of magnets, and thus to induce a great quantity of electricity.

When the ship is in motion the donkey engine is dispensed with and the apparatus is propelled by the steam from the large engine. The wires from the magneto-electric machine can be conducted to any part of the ship, to the reflector. On the occasion of our visit the reflector was placed upon the captain's bridge.

This reflector is itself a triumph of art. It contains two carbon pencils placed one above the other, and driven by clockwork that runs five hours without winding. This clockwork, invented by Foucalt, feeds the carbon points exactly in the ratio of their combustion, and there is thus no interruption in the light. As the electric current passes from one carbon point to another, a great light is produced, and this light is concentrated and rendered parallel and greatly strengthened by the parabolic mirrors and Fresnel lenses now employed.

The reflector can be turned in any direction, and the objects upon which it fell were illuminated as definitely as they would be in the direct sunlight. Nothing could exceed the beauty of the effect when the reflector was made to sweep the horizon. One object after another was brought from darkness into brilliant light. The passing ferryboats with their crowd of passengers were perfectly distinct, and the names of vessels on the river were clearly revealed. Any one in Hoboken, or in fact, at a much greater distance, would be able to read a newspaper with perfect ease as long as the reflector was pointed towards him.

A light arranged in this way will cast its rays forty miles; and upon one occasion, where it was necessary for the French government to overtake a despatch-boat, the vessel sent in pursuit was able by means of the electric light, to detect the despatch boat at a distance of several miles, and thus to overtake it. Wherever the path of the rays fell the brightest light prevailed, and great must have been the astonishment of persons lurking in the darkness of the wharfs to find themselves suddenly brought out into the light of noonday.

Faraday once remarked, after witnessing a similar exhibition, that "in order to obtain an equal amoont of light from an oil-flame, the size of the flame must be two thousand times as large as that of the electric light, and the apparatus must be proportionately larger." Such testimony as this, coming from the great discoverer of the principle upon which the light is founded, is of the greatest value. As the electric light can be seen through the heaviest fog, all vessels provided with it would be secure from danger of collision.

We have already alluded to the trifling cost of the light as compared with its power, and we hope experiments will be made with it on our seacoasts, on the ferryboats and upon ocean steamers. The apparatus of the French Electric Company must be pronounced to be highly successful.—*N. Y. Evening Post.*

## The Dangers of Petroleum—A Remedy Suggested.

The recent frightful disaster on a railroad in Wales (Eng.), caused by the sudden combustion of petroleum, has directed attention to the means of preventing such accidents in future. Various plans are suggested in the English papers, and, as usual, there is a great difference of opinion. Incidentally, the question of the transportation of petroleum on shipboard is under discussion. A Paris letter writer says:

"M. Verstraet, a chemist, who has occupied himself with a plan of heating the boilers of steam vessels by means of petroleum, has pointed out a means of protecting ships from these terrible disasters. The fundamental principle is the same as that upon which he feeds the fireplace of the boilers by means of petroleum. The gases of the oil reservoirs are conducted to the fireplace by a current of air. They are thus utilized, and at the same time the danger of their making their way into the various compartments of the ship is effectually obviated. In like manner, M. Verstraet proposes to sweep away, from time to time, by a current of air, the gases accumulated in ships laden with petroleum, and thus to render their atmosphere inexplosive. At certain hours of the day, by means of a simple ventilator, which a man's arm can set in motion, a quantity of air should be made to pass through the holds of the ship, and should then be expelled into the atmosphere. By this simple maneuvre, which a police regulation might render obligatory in every port upon all ships laden with petroleum, we should avoid great misfortunes, likely to be of very frequent recurrence so long as the authorities shall not have taken precautions against the carelessness and recklessness of sailors."

A foreign scientific review has some apposite remarks on the same subject. The cause of fires on board petroleum ships is always the same—the ignition of an atmosphere saturated with carburetted vapors. The writer says:

"Petroleum emits, at the ordinary temperature, gases so subtle that they find their way into the best closed places. There, where air alone is supposed to be, an explosive mixture exists. The smallest lighted match sets fire to the gas, which explodes with formidable power. A mechanical effect is produced which upsets and breaks the internal parts of the ship and fills the air with flames. Everything is impregnated with fire, everything burns; those sailors who are not already killed by the explosion are plunged into an ardent brazier, and completely enveloped in flames. Sailors accustomed during the whole voyage to the smell of the oil do not generally perceive that the gas is invading their cabins."

**Improvements in Gas Manufacture.**—At the recent annual meeting of the British Association of Gas Managers, it was stated that upwards of twenty new appliances in the manufacture and distribution of gas were introduced last year. Amongst the foremost of them was the plan of using a mixture of small coal with shale oil, as a substitute for cannel coal, for the production of gaslight of high illuminating power.

## PATENT CLAIMS.

**Pertaining to Gas, Water, etc.**

82,480.—Lamp Burner.—Edward C. Blakeslee, assignor to Benedict and Burnham Manufacturing Co., Waterbury, Connecticut.

I claim, combining with a perforated base, provided with the vertical strips of metal F, and cone C, the bulb E, and wick-tube B, when the same shall be constructed and arranged to operate substantially as shown, and for the purposes indicated.

82,534.—Steam Generator.—Victor Langlois, Cherbourg, France.

I claim, 1st. The construction and arrangement of the tubes a, having the threaded ends b, and external caps c, the lead packing f, rings A, and plates P P', substantially as herein shown and described.

2d. The various tools for effecting such work of the plates and tubes as I have described, and also for putting up and off of the said movable tubes, substantially as described.

82,620.—Tool for Gas Fitter.—Jacob Himmer, Hartford, Connecticut.

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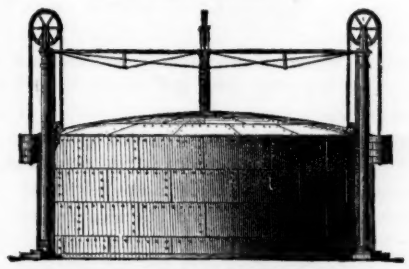

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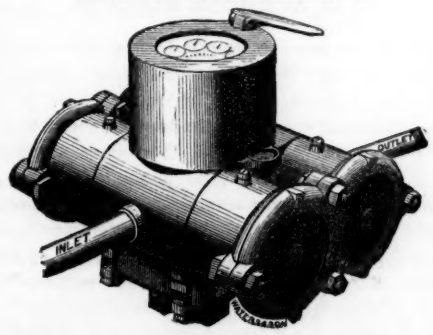


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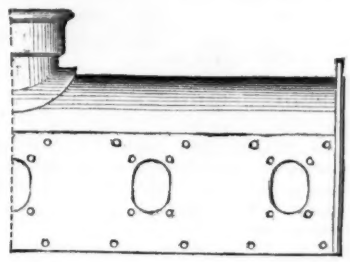

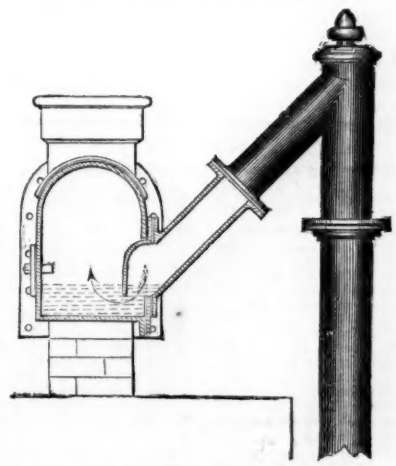

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[NOTE BY PROFESSOR WURTZ.—Contributions and items for which I am, as a Scientist, individually responsible, will have attached my full name or initials.—H. W.]

FRIDAY, OCTOBER 16, 1868.

WISHING TO MAKE this Journal an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of those subjects a pleasure, or a profession.

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## Answers to Correspondents.

N. G., of Mass.—Your plan of carrying the heat from your furnaces over the top of the boiler, so as to save fuel, will accomplish the object, but we are adverse to advising you to do so, because the heat may be too high above the water-line, and the boiler thereby injured and rendered unsafe. You should use two or three fire bridges under the boiler, and thus retain the heat for a longer time in contact with the water surfaces.

T. H., of Ill.—The steam and water in a boiler are both of the same temperature at all pressures. If the pressure is 60 lbs. on the square inch, the temperature of steam and water is 305° Fahrenheit.

J. K., of Ark.—We are doubtful about the novelty of your improvement, and advise a preliminary examination to be made at the Patent Office. This we can do by receiving from you the usual fee.

Reader, of Tenn.—We have little doubt that the mineral enclosed in your letter is iron pyrites; but if you wish to test it, dissolve it in hot nitric acid, and drop in a little aqua ammonia, when, if it contains copper, the solution will show a blue color.

D. P., of Pa.—Clegg was the inventor of the first self-acting apparatus for the measurement of gas. The principle of the Archimedian screw was first applied to gas meters by Mr. John Malam.

E. J., of Mich.—The specific gravity of hydrogen gas is 0.0692; that of carbonic acid 1.5290: of oxygen, 1.1056.

H. E. B., of Ohio.—Cyanogen is a compound of nitrogen and carbon. It is an inflammable gas, burning with a beautiful peach-blossom colored flame. Its formula is $C_2 N$.

## NEW FEATURE.

It has been suggested to us, and we accept the suggestion as pertinent, that the interest of our Journal would be more enhanced by the devotion of some space to setting forth the discoveries and advances which are now being made so rapidly in the Science of Chemistry, many of which have more or less bearing on the specialties which come within our scope. Chemists all take an interest in the gas manufacture for example, and gas men are led by their studies necessarily into the field of Chemistry. In accordance therefore with our determination to increase the usefulness, and elevate the status of our Journal in every way we can, we shall hereafter give more attention to the selection, abridgment, and translation from standard chemical periodicals of novel contribution to the science; and shall solicit also original contributions from our own native chemists, than whom none are more able to contribute such.

In this connection, we are happy to inform our readers and patrons that we have secured the services of our well known Chemist and Scientist, Professor Henry Wurtz, as assistant editor, and a regular contributor to our columns, and as special Consulting Chemist for the Journal.

## CLAY AND IRON RETORTS.

During the past few years the comparative merits of clay and iron retorts has attracted much attention from gas-engineers, and the advocates of each have been active in endeavoring to promote the ascendancy of their favorite article. Numerous practical trials comparing their relative durability, economy, and carbonizing power have, from time to time been made, and many facts worthy of attention have been elicited respecting their comparative excellence. It may seem a matter of much surprise to those unacquainted with the details of these practical essays, that a substance apparently so friable and brittle in its nature as clay should have superseded cast-iron to a great extent, and received the highest encomiums from every possible source. Yet such has been the case, and this important reform, which but a few years ago met with many obstructions in having to withstand a vigorous prejudice, has lately been gaining ground with great rapidity, and promises ere long to meet with approbation.

The introduction of clay retorts seems to be due to Mr. Grafton, who, as early as the year 1820 took out a patent in England for their use. His retorts were at first square, but were soon after altered to the shape of a broad shallow ⏢, and were constructed in sections of about sixteen inches in length, luted together with fire-clay. These retorts were five feet wide, eighteen inches high, and seven feet long, resembling an oven in their general contour. This shape was used for many years in some of the provincial establishments in Great Britain; and are perhaps still employed to some extent, although they have been generally replaced by the oval, circular, and particularly the common ⏢ shaped retort.

The gas works of Scotland were among the first to appreciate the value of clay retorts, and their use is now almost universal in that country. They were there employed for a considerable period before their general introduction into England, where, as their superiority became more widely known they were gradually adopted, and now the proportion of iron and clay retorts in operation in the whole of Great Britain greatly preponderates in favor of the latter. In this country clay retorts are rapidly gaining the confidence of gas-light companies, and we are safe in saying that wherever they have been fairly tested, they have met with warm approbation, and will doubtless supersede those of iron.

The superior qualities claimed for clay retorts over those of made of iron, are as follows: Their cost is less than iron; they are more durable; they have more carbonizing power; they produce a greater quantity and a better quality of gas. There are some parties who still advocate the use of iron retorts, and who, of course, will not admit these claims, but those who have adopted the clay retorts are firm in their belief that all of the qualities above mentioned are amply sustained. As to the first cost of a retort, it is quite unnecessary to attempt to prove the superior economy of clay over iron, as to all who have the slightest familiarity with the subject, it must be apparent.

The durability of a retort is a subject of great importance in an economical aspect, and unless this is attentively studied and abundantly demonstrated, no comparative essay can be regarded as conclusive. But as regards the relative durability of iron and clay retorts, the results of the trials have satisfactorily proved the superiority of clay. According to Mr. Christie, of London, the average duration of iron retorts as worked there, and the provincial towns of England, is ten months, whereas in London some clay retorts have been in use for four, five, and six years, and those which have been used two and a half to three years, may be seen at most any works where they are employed. This, however, may be a rather exaggerated statement, although a duration of two years has frequently been obtained. At the South Metropolitan Works, in London, seventeen months has been considered a fair duration for clay retorts, each one having produced 1,800,000 feet of gas, the expenditure of coal being no greater than that of iron retorts. Mr. Barlow, the editor of the *Journal of Gas Lighting*, estimates 700,000 cubic feet of gas as the average yield of iron retorts.

If we remember rightly, it was in 1859 that a report was made by the chairman of the City of London Gas Company, wherein the strongest testimony was adduced in favor of clay over iron retorts. Out of 468 clay retorts, in constant use by the above company, 196 had been in operation for over four years, and were all in the most efficient state for generating gas.

The partisans of iron retorts have contended that a much greater amount of fuel is required for carbonizing with clay retorts. It is true that the heat deemed most suitable for generating gas from them is several hundred degrees higher than that used with iron, but this greater intensity is efficient in producing a larger amount of gas than would be generated at the lower degree of heat required by iron retorts. They also argue that the high heat necessary to effect a complete decomposition of coal in clay, causes a deposition of carbon from the gas, thus materially lessening the illuminating power, and Dr. Fyfe, a celebrated chemist, estimates that every 225 grains of carbonaceous deposit, indicates the decomposition of fully one cubic foot of olefiant gas. But as clay retorts have been for a long time in operation in large companies in this city and elsewhere, where daily photometric tests are made of the gas produced, this depreciation would have been at once detected had it occurred, and we must therefore conclude it to be entirely imaginary.

Owing to the porosity of clay retorts when new, some engineers have deemed the employment of exhausters far more necessary than when iron retorts are used, but we have frequently conversed with gentlemen practically acquainted with the manipulation of clay and iron retorts, who consider the exhauster as indispensable for the one as for the other. In large establishments it is regarded as a

great adjunct to the successful production of gas, if not an absolute necessity, owing to the great length of the hydraulic main, and the large extent of pipes; but in small works, where iron retorts are now used without an exhauster, clay retorts may be adopted without fear of any greater loss by leakage than is experienced in the employment of iron.

Doubts have arisen in the minds of some gas engineers as to the economy of using clay retorts in small gas works where but one or two benches are set. As large works derive such advantages from the introduction of clay, we do not see why they should entail any loss on establishments of smaller size.

This subject might be almost indefinitely extended, as it is of great importance, and eminently worthy of consideration. Although a large number of gas-light companies in this country have adopted the use of clay retorts, a great proportion, particularly of small works, are dilitory [in making a trial of their merits. We do not doubt, however, that an advance will be accomplished in this respect, and that establishments of moderate size, as well as works of greater magnitude, will ere long appreciate their superior value.

## GAS FOR MAZATLAN.

We learn from the San Francisco *Times*, that several capitalists are figuring up the cost of supplying the Mexican city of Mazatlan with gas pipes from San Francisco. The town has, it is said, about 12,000 inhabitants, and it is supposed that the Mexicans will become liberal patrons of gas. Experience has shown, however, that the use of gas when introduced, would not be so general among the inhabitants as is apprehended. The majority are in humble circumstances, and are content with other less costly illuminators.

About ten years ago this experiment was tried by citizens of San Francisco, when only about one family in ten seemed disposed to introduce gas in their houses, while the ayuntamiento flatly refused to have anything to do with it for street lighting. However, perhaps the City Fathers of Mazatlan have become more liberal in their views, as reliable accounts have reached them of gas burning in California and other places.

## ARCHER & PANCOAST MANUFACTURING COMPANY.

Pertinent to the great benefits of artificial illumination and next in its order perhaps, may be considered the manufacture of gas fixtures, chandeliers, etc. Among the foremost of the manufacturers in the country is the Archer & Pancoast Manufacturing Company, whose manufactory and sales rooms are at Nos. 9, 11, and 13 Mercer street, New York city. This house was founded in Philadelphia in 1841, by the senior partner, E. S. Archer, with a branch in New York until 1859, when the increase of business made it desirable to make an entire change in favor of the latter city, where they now occupy large and commodious buildings reaching a distance of 200 feet from Mercer to Greene streets, and fronting upon both streets.

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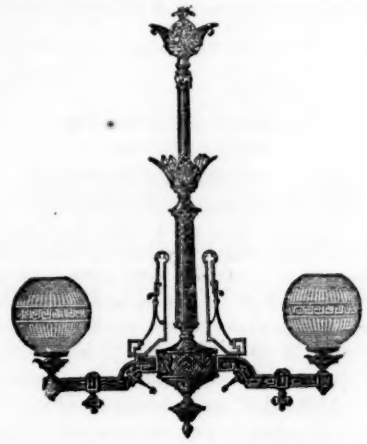
See advertisement in another column.

**Errata.**—In our issue of the 2d inst., in "Answers to Correspondents," to O. P., of Vt., third line, instead of "intensity of light varies *immensely*," read *inversely*.

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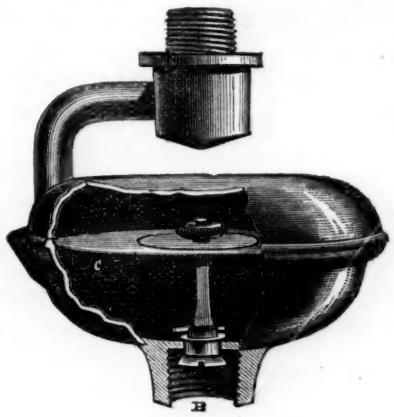

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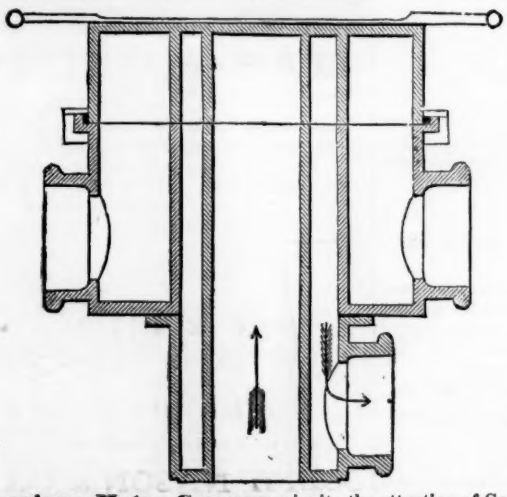

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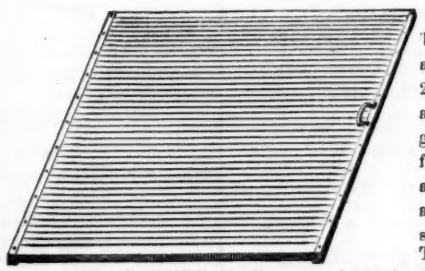

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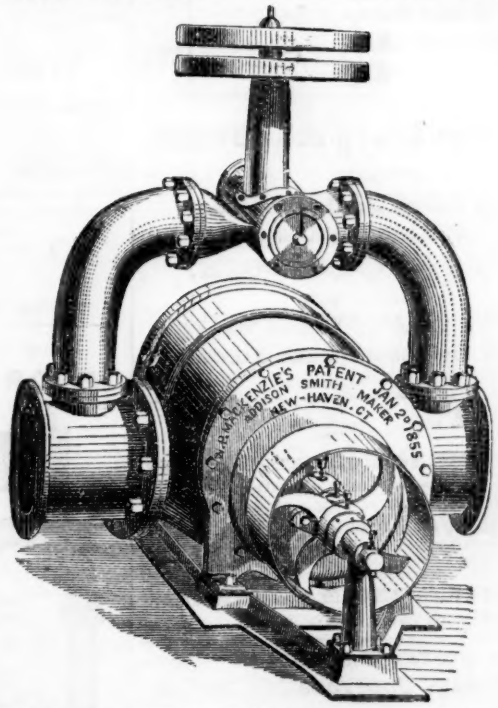


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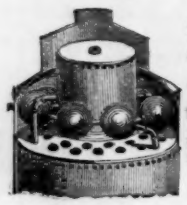

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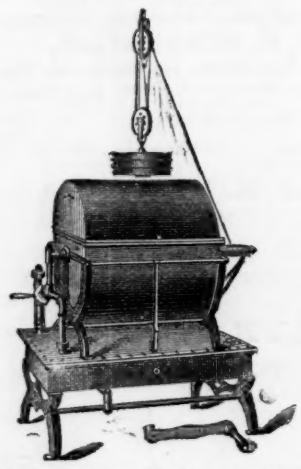

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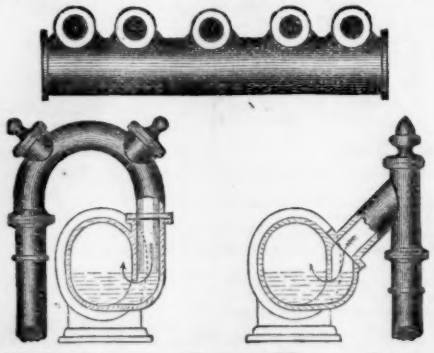

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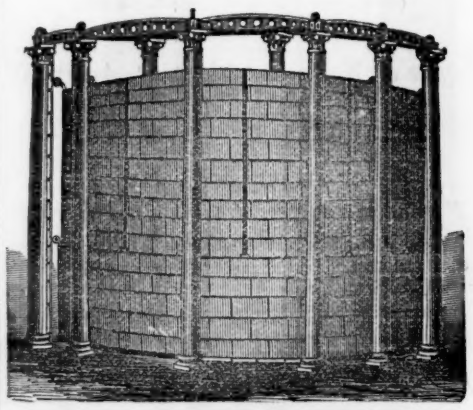

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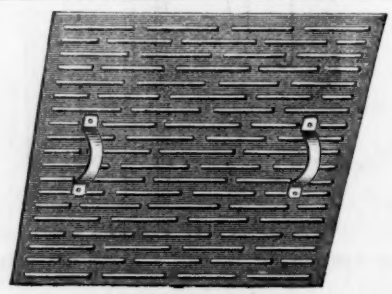

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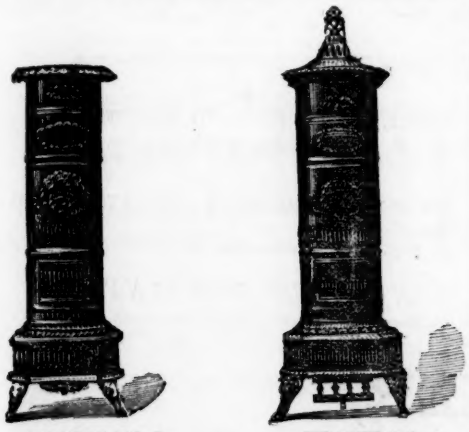

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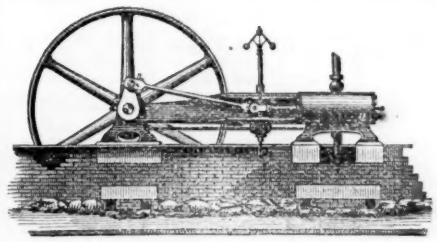

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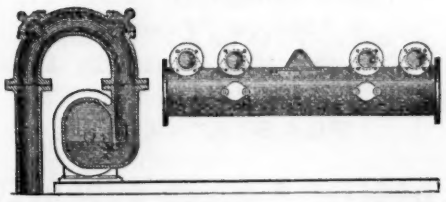

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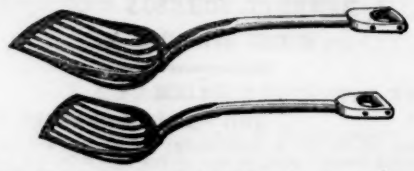

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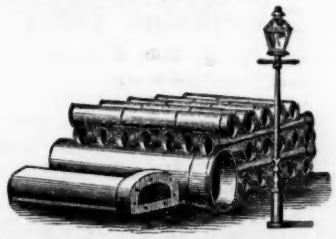

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| San Jacinto, | .. " | 20 |
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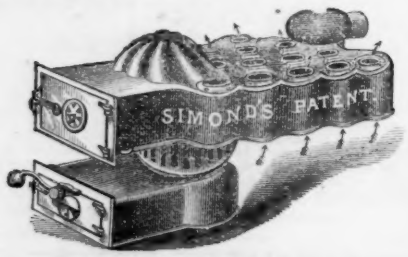


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For further information apply to J. H. SIMONDS, No. 52 Cliff street, New York.

## Miscellaneous Items.

—Mr. John Ward, of Port Glasgow, has invented an arrangement for supplying light under water; it is an ordinary lantern, with two tubes for the descent and ascent respectively of air. Mr. Ward thinks that the heat from the flame will cause the necessary current of air.

—The iron bridge on the line of the Catseauqua and Foglesville Railroad is the longest iron structure of the kind in the United States, the extreme length being 1,165 feet, and hight 90 feet.

—Before 1829 it required about five pounds of coal to carry one a mile. In that year George Stephenson reduced it to 2.41 pounds of coke. It can now be brought to less than a quarter of a pound per ton per mile.

—Among the *brevets d'inventian* recently granted in France, we read of a strong coffer, the peculiarity of which seems to be that if fraudulently opened it will kindle a Bengal light, brilliant enough to assemble a multitude, who will firmly believe that the house is on fire.

—A young machinist in Detroit, Mich., has made a locomotive engine and tender complete, about four feet in length, and weighing only 300 pounds. Attached are head light, bell, whistle, and every part to be found in a regular locomotive engine. It can be run with 15 pounds of steam, though as high as 30 pounds can be put on if necessary. The boiler has 13 flues. The maker has refused $2,500 for it.

—A meeting of the Association of German Civil Engineers was held at Duseldorf recently. The association numbers 1,500 members, of whom about 500 were present. Among the most important motions was one to the effect that a series of experiments on a very large scale should be undertaken with a view to the investigation of the whole subject of the bursting of boilers, and the means for its prevention.

—M. Caron has published a short account of the way in which he makes his magnesian cylinders for the Drummond light. He takes magnesia which has been purified from alkalies and other alkaline earths, and after moistening it with a solution of boracic acid, he presses it into molds. The reason for separating the other alkaline earths and alkalies is that their presence would affect the color of the light. The boracic acid would probably give a greenish tinge to the flame.

## Washington Territory Coal Mines.

A correspondent of the San Francisco *Times*, writing from Port Townsend, W. T., mentions the interesting fact that an immense deposit of coal has been discovered on the Skookum Chuck Creek, some fifty miles from Olympia, in the direct route over which a railroad (for which a bill to grant a charter and subsidies is now before Congress) must pass. This coal was discovered some years since, and a test made in San Francisco, which was highly satisfactory, but subsequent discovery of coal at Bellingham Bay caused this to be abandoned, as the Bellingham Bay mines were easier of access to shipping. Recent examinations, however, have proved that this coal is not only of superior quality, but that it exists in immense deposits over a vast field. The veins crop out on the banks of the Skookum Creek, one of which is seven feet thick, another nine feet, and one fifteen feet. I have tested several specimens of this coal, and find it free from sulphur, with but little smoke, and a bright clear flame. If the outcropping gives evidence of so many excellent qualities, it is but reasonable to suppose that the coal in the interior of the vein will be much superior to any yet found on the coast.

There is also in the immediate vicinity an abundant supply of sandstone of fine quality. The color is blueish gray, and it is equal to fire brick in its powers of resisting heat. It is easily worked when first quarried but grows hard with exposure to the air. I have seen several fireplaces made of it which have stood well for years.

**New Light.**—Another new light is said to have been recently discovered in Turin, Italy, applicable both to photography and social life, and costs little or nothing. It does not dazzle the eye like the electric light, nor is it intermittant like that produced by magnesium. We are anxious to know what it is.

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